

Space Weather Technical Forecast

Issued on Saturday, 28 October 2023 at 13:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Coronal hole enhancement Days 2-3 (29-30 Oct) with G1-G2/Minor to Moderate Geomagnetic Storms expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Low with x-ray activity at background levels and isolated low level C-class flares were observed. There are currently five numbered regions on the visible disc, all of which are small and simple. Most regions are showing signs of gradual decay. No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, started at slightly elevated levels around 440 km/s and gradually declined to background levels before picking up again by 28/0600 UTC to reach slightly elevated again. Density has been at near or slightly above average levels. The Interplanetary Magnetic Field (IMF), started at weak levels before rising to reach Moderate levels after 28/0200 UTC. The north-south component, Bz, was mostly orientated southward and has fluctuated between weak and moderate levels, ranging between +8 and -9nT. Phi angle has remained predominantly positive (away from the Sun). Geomagnetic activity was at Quiet to Unsettled levels (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was largely at background to moderate levels, peaking at 301 pfu at 27/20005 UTC. The associated 24-hour fluence remains well below the Active (1e8 integrated pfu) threshold, despite a gradual upward trend, but has levelled off since midnight. The observation at 28/0000UTC was 6.94e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Very Low or Low activity is expected, with isolated C-Class flares. There is a slight chance of isolated M-flares, mainly from AR3473 but also potentially from the arrival or return of sunspot regions to the visible disc.

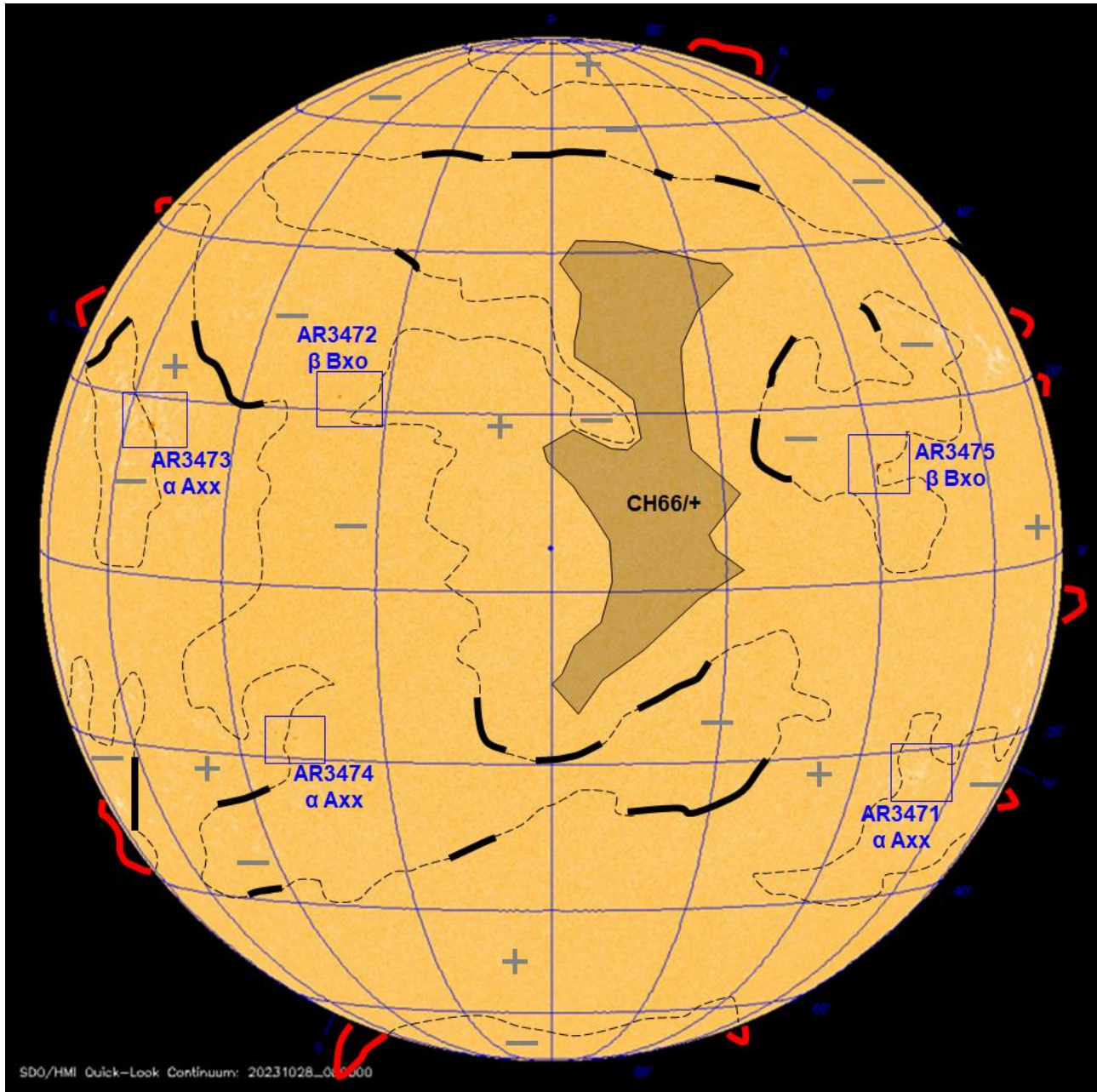
Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs expected. The next solar wind enhancement is expected to arrive by Day 2 (29 Oct) from large coronal holes CH66. The solar wind is expected to become elevated to strong. Unsettled to Active (Kp 3-4) geomagnetic activity is expected until the arrival of the high speed stream (HSS) and associated CIR. Then G1-G2/Minor to Moderate Geomagnetic Storms (Kp 5-6) are most likely Days 2-3. Activity is then expected to decline during day 4 (31st) as the influence of the HSS wanes.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at Background. High energy electron flux (greater than 2MeV) is expected to remain at background to moderate levels. Little change is then likely until day 4 (31st) when flux levels are likely to rapidly increase under the influence of the HSS, probably reaching High levels

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by the end of the period. The associated 24 hour fluence is forecast to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend today and again at the end of the forecast period.

Figure 1. Solar Analysis Valid 0800UTC, 28 October 2023.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

There are currently no Earth-directed CMEs forecast.

The next solar wind enhancement is expected to arrive by Day 2 (29 Oct) from large coronal hole feature CH66/+. The model output from the Met Office SWPM is not considered to provide good guidance for wind enhancement, due to the non-recurrent nature of the coronal hole and influence from CMEs during the last rotation. Solar winds are anticipated to reach elevated to strong levels. MOSWOC ENLIL assessment of the solar wind environment is currently moderate confidence and indicates the HSS to have started around 24 hours ago. The early onset produced by Enlil may be the result of modelling the return of CH54/+ which previously was significantly more advanced on the disc.

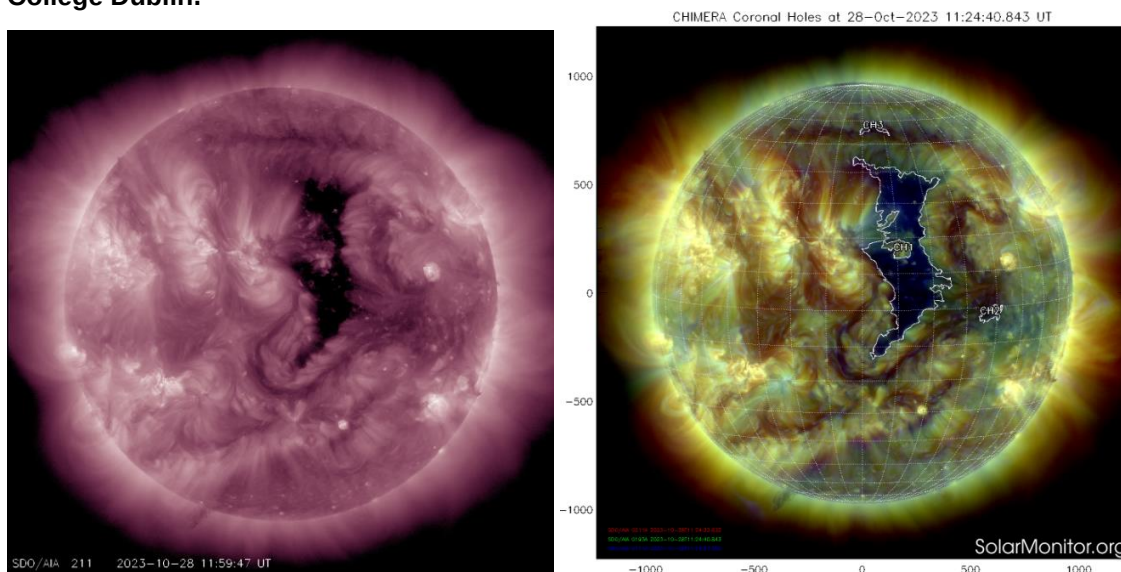
Geomagnetic activity is likely to be Unsettled to Active until the arrival of the high speed stream (HSS) and associated CIR due by Day 2 (29 Oct). Then G1-G2/Minor to Moderate Geomagnetic Storms (Kp 5-6) are most likely Days 2-3. Activity is then expected to decline during day 4 (31st) as the influence of the HSS wanes.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	50	70	80	50
Strong	G3	No	1	10	10	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Latest SDO aia-211 image showing CH66/+ near centre disc, and analysis of CHs by Trinity College Dublin.

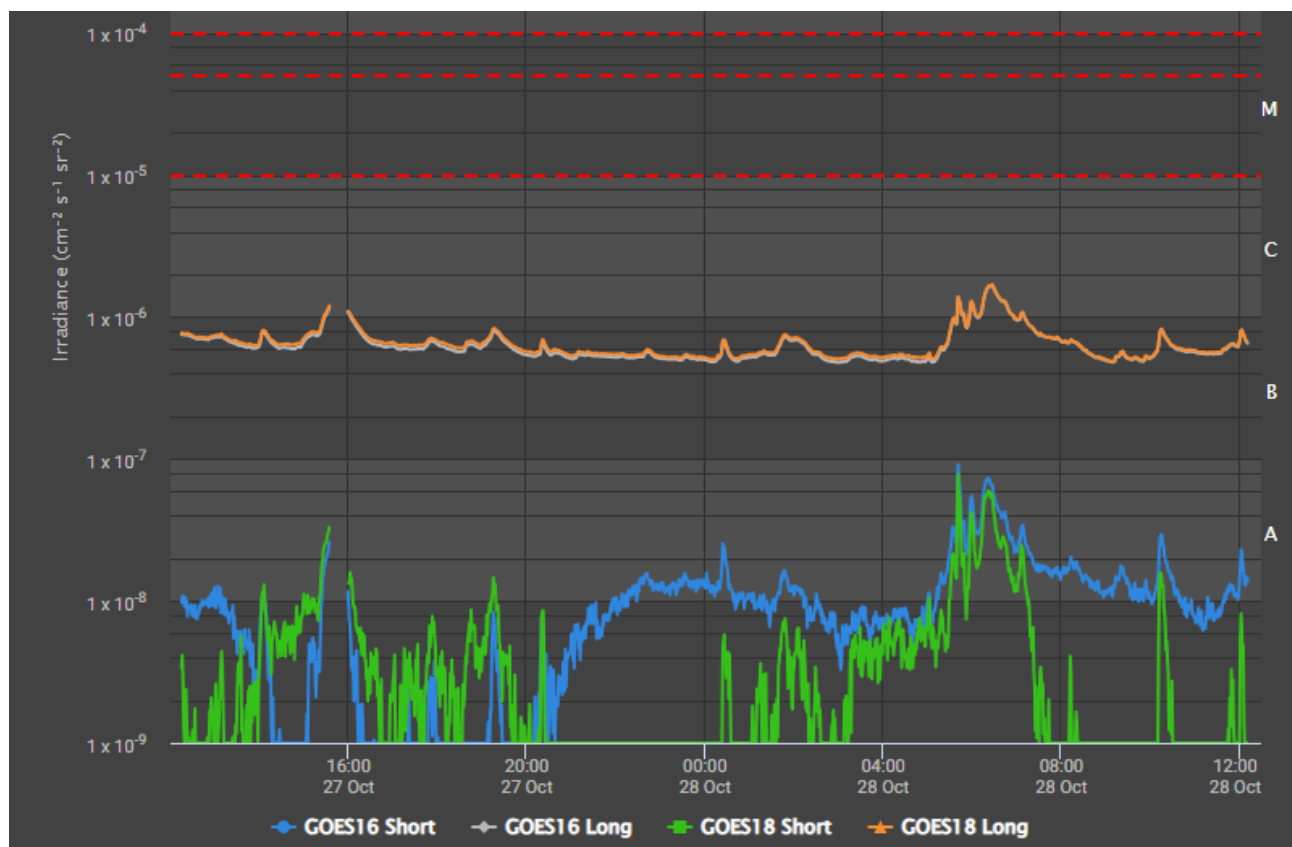


Radio Blackouts - X-Ray Flares:

There are currently five numbered active regions on the visible disc and these all appear to be small and magnetically simple from available imagery. One previously unnumbered region has faded, and AR3468 is now barely visible. Most regions are showing signs of gradual decay and are weak. New or returning regions may arrive onto the visible disc, and there remains a slight chance of an isolated M-class flare throughout this guidance period. There are also a number of rather large filaments on the visible disc that have the potential to disrupt or lift-off, producing flares and associated CMEs. These will be monitored during the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flux at GEO as measured by GOES showing low level Common class flares in past 24 hours.



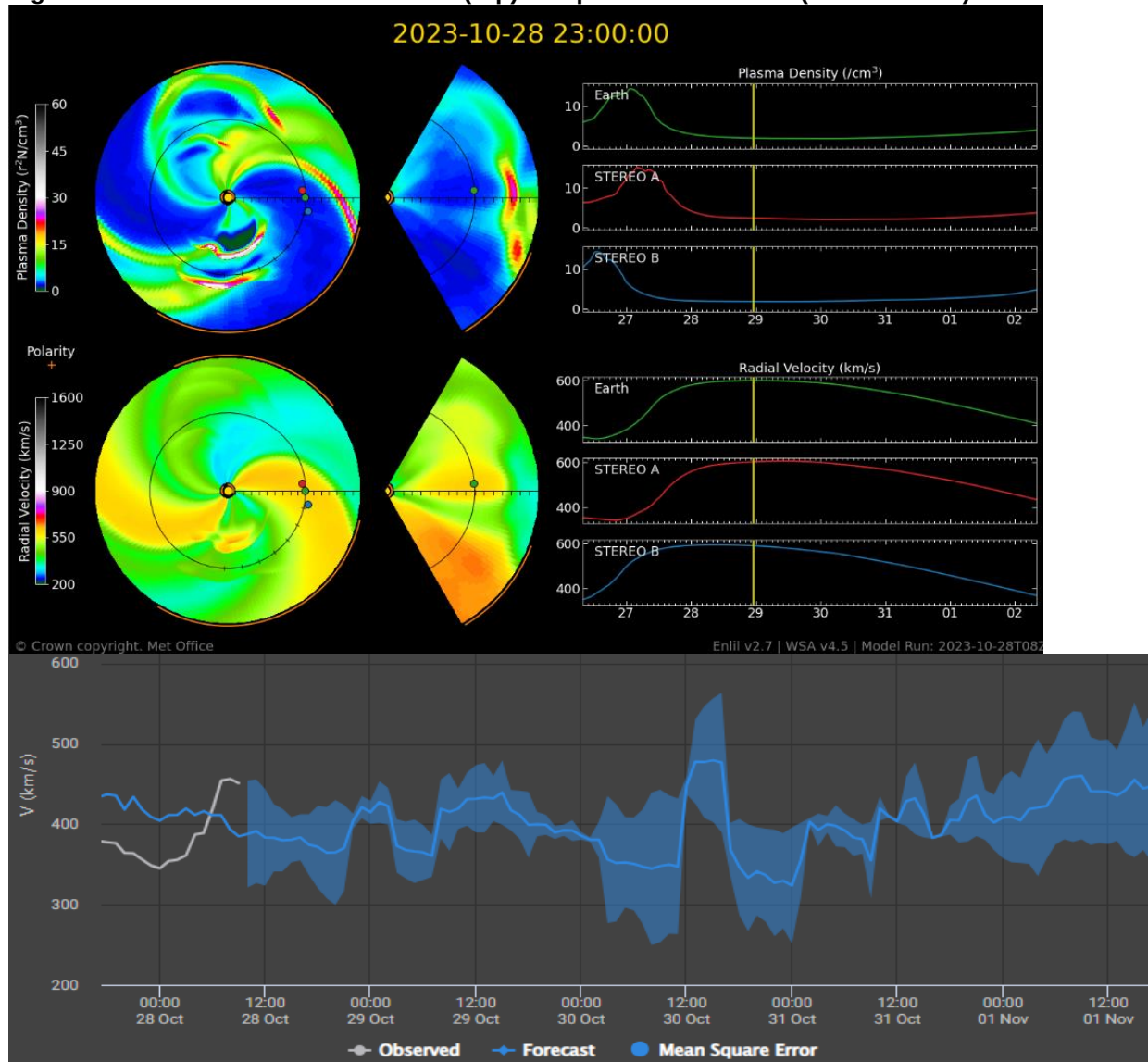
Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels in the absence of significant sunspot regions on the visible disc.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 [*]	No	1	1	1	1

^{*} S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

Figure 4: Latest Met Office Enlil model (top) and persistence model (SWPM below).



High Energy Electrons Event ($\geq 2\text{MeV}$):

Electron flux observed by GOES16 at GEO is at background to moderate levels, due to a slight increase in high energy electrons through the Van Allen Belt following the recent coronal hole enhancement from CH64. Flux levels are expected to remain at similar levels given the onset of anticipated geomagnetic activity in the next couple of days. Little change is probable until late day 4 (31st) when flux levels are likely to quickly increase under the influence of the HSS, probably reaching High levels by the end of the period.

The associated 24 hour fluence is forecast to remain below the Active threshold ($1\text{e}8$ integrated pfu), with an increasing trend during day 4 (31st). This is supported by REFM, though persistence provides a poor guide due to influence of CMEs on the previous rotation.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	10	10	20	50
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output showing little overall change.

